On Extended Simple Eco-grammar Systems

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The concept of the eco-grammar system (the EG system, for short) has been introduced in [3] as a model of communities of agents which interact with their common shared environment. Several aspects of these systems were discussed in [4] and [7], properties of a restricted variant, called simple eco-grammar systems, were studied in [5], [1], [9], [2], [6], and [8]. Briefly, a simple eco-grammar system consists of several agents (represented by sets of context-free rules) and an environment (given by a set of $0L$ rules). At any moment of time, the behaviour of the system is described by the state of the environment which is a string over the alphabet of the system. The environmental state changes by derivation steps. In a derivation step the agents act on the string by applying one of their context-free rules - each agent rewrites only one letter - and the environment replaces, according to its $0L$ rule set, in a parallel manner the symbols where the agents do not perform any action.

Starting from an initial string representing the environment, a lot of sequences of strings following each other arise which describe the evolving system. The language generated by the eco-grammar system is the set of strings which can be obtained from the initial environmental state by a sequence of derivation steps. In the case of extended simple eco-grammar systems only those strings belong to the determined language which are over a distinguished subset of the alphabet of the system, the terminal alphabet. This notion was introduced and some basic properties were examined in [6].

Following that line, in this contribution we deal with a more sophisticated version of the derivation, the team behaviour of the extended simple eco-grammar systems: in each derivation step from the n agents exactly k or at most k have to perform an action. We describe the behaviour and the generative power of these systems according to some size parameters: the total number of agents, the number of agents being active in a derivation step. We examine the hierarchy of the language classes generated by extended simple eco-grammar systems with and without λ-rules.

The results demonstrate that while in the non-extended case the size parameters of the teams and the agent population have influence on the power of the system, in the extended case these parameters are not important: we obtain a collapsing hierarchy.

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